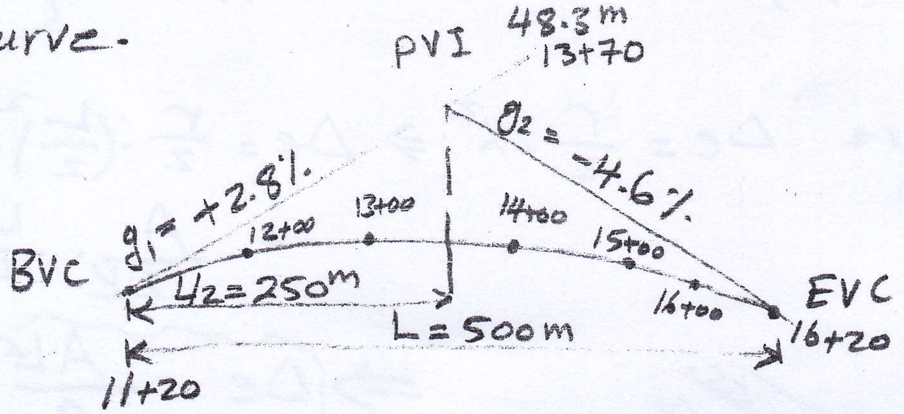
Example 1/ The vertical curve contains two grade, the first grade was upward 2.8% while the second one downward 4.6%. These grades meet at intersection point (PVI), which the Reduce level and station of (PVI) were (48.30 m) and (13+70), respectively. The length of vertical curve was 500 m. Find

1) The Reduce levels and stations of the tangent points.
2) The Reduce levels of the curve @ 100 m interval.
3) The station and Reduce level of highest point on the curve.



Sol.

1) Elevation of BVC = Elevation of PVI $- g_1 * \frac{L}{2}$

$$= 48.30 - \frac{2.8}{100} * 250 = 41.30\ m$$

Elevation of EVC = Elevation of PVI $- g_2 * \frac{L}{2}$

$$= 48.3 - \frac{4.6}{100} * 250 = 36.80\ m$$

station of BVC = station of PVI $- \frac{L}{2}$

$$= (13+70) - (2+50) = 11+20$$

station of EVC = station of PVI $+ \frac{L}{2}$

$$= (13+70) + (2+50) = 16+20$$

2)

$y = g_1 x + \text{Elev. BVC}$

	station	x	$g_1 x$	Tangent Elev(m)	Δy (m)	Curve Elev. (m)
BVC	11+20	0	0	41.30	0	41.30
	12+00	0.8	2.24 *	43.54 **	−0.47	43.07
	13+00	1.8	5.04	46.34	−2.40	43.94
PVI	13+70	2.5	7.00	48.3	−4.62	43.68
	14+00	2.8	7.84	49.14	−5.79	43.34
	15+00	3.8	10.64	51.94	−10.67	41.26
	16+00	4.8	13.44	54.74	−17.03	37.70
EVC	16+20	5	14.00	55.3	−18.50	36.80

* $g_1 x = 2.8 * 0.8 = 2.24$

** $y = g_1 x + \text{Elevation of BVC}$
$= 2.24 + 41.30 = 43.54$

$A = g_2 - g_1 = -4.6 - (2.8) = -7.4$

$\Delta e = \dfrac{A \cdot L^{\text{stat.}}}{8} = \dfrac{-7.4 * 5}{8} = -4.62$

$\Delta y = 4 \cdot \Delta e \cdot \left(\dfrac{x}{L}\right)^2$

Some calc. of Δy

$= 4 * -4.62 * \left(\dfrac{0}{5}\right)^2 = -0$

$= 4 * -4.62 * \left(\dfrac{0.8}{5}\right)^2 = -0.47$

$= 4 * -4.62 * \left(\dfrac{1.8}{5}\right)^2 = -2.40$

etc.

Curve Elevation = Tangent Elevation + Δy

Some calc. of curve Elevation

$= 41.30 + 0 = 41.30$ m

$= 43.54 - 0.47 = 43.07$ m

$= 46.34 - 2.40 = 43.94$ m

We can solve the branch 2, as follows:

$y = \frac{r}{2}x^2 + g_1 x +$ Elev. of BVC

station	x	x^2	$\frac{r}{2}x^2$	$g_1 x$	* Curve Elevation (m)
11+20	0	0	0	0	41.30
12+00	0.8	0.64	−0.47	2.24	43.07
13+00	1.8	3.24	−2.40	5.04	43.94
13+70	2.5	6.25	−4.62	7.00	43.68
14+00	2.8	7.84	−5.80	7.84	43.34
15+00	3.8	14.44	−10.69	10.64	41.25
16+00	4.8	23.04	−17.05	13.44	37.69
16+20	5	25	−18.50	14.00	36.80

$$r = \frac{A}{L} = \frac{g_2 - g_1}{L} = \frac{-4.6-(2.8)}{5} = -1.48$$

* Curve elevation $= \frac{r}{2}x^2 + g_1 x +$ Elev. of BVC

$= 0 + 0 + 41.30 = 41.30$ m

$= -0.47 + 2.24 + 41.30 = 43.07$ m

------ etc

c) The station of highest point is

$$r = \frac{A}{L} = \frac{g_2 - g_1}{L} = \frac{-4.6-(2.8)}{5} = -1.48$$

$$x_o = \frac{-g_1}{r} = \frac{-(2.8)}{-1.48} = 1.89 \text{ in station} \Rightarrow 1+89$$

To find the elevation of highest point, we substitute the value of xo insted of x in general equation of vertical cure, as follows:

$$y_o = \frac{r}{2} x_o^2 + g_1 x_o + \text{Elevation BVC}$$

$$= -0.74(1.89)^2 + (2.8)(1.89) + 41.30 = 43.95\,m$$